

SAVANNAH RIVER BASIN WATER BUDGET AND RESERVOIR OPERATION MODEL

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Abstract. A model was developed to achieve the best possible mix of benefits from the water resources of the Savannah River basin. The model including, but not limited to, inflows, net evaporation, power curves, channel characterization, water use in the basin, municipal and industrial intake elevations, quantification of hydro electric production, and recreational, water quality and supply, and flood control benefits. The model output shows the impact and tradeoffs among all uses in the system as a result of a given operational criteria.

INTRODUCTION

The Savannah River Basin is a long narrow basin, with a maximum length of 250 miles and a maximum width of 70 miles. It covers a total area of 10,579 square miles, of which 179 square miles are in North Carolina, 4,530 square miles are in South Carolina, and 5,870 square miles in Georgia. The Savannah River flows through the basin in a southeasterly direction across the Piedmont Plateau and Coastal Plain to the Atlantic Ocean. Approximately 45 miles of the lower Savannah River are influenced by tidal flow.

The Savannah River flow is regulated by 6 Georgia Power, 3 Duke Power, 1 SC Electric and Gas, and 4 U.S. Army Corps of Engineers (ACOE) dams. While the other dams impact flows somewhat, the ACOE impoundments-Hartwell, Richard B. Russell and J. Strom Thurmond Lakes- form a chain of lakes approximately 120 miles long and dramatically effect the quantity of flow in the river at any given time. The multi-purpose impoundments serve fish and wildlife, flood control, hydropower, navigation, water supply and recreation needs in a way that has become increasingly scrutinized. Several cities, counties, farms and businesses rely on the river for water, power, navigation, recreation and protection from floods.

During the 1980's, rainfall in the Savannah River basin has been well below normal, with the most severe

periods observed during 1981, the annual rainfall deficit at Walhalla, South Carolina totaled 20.26 inches or 33 percent below normal. Since January 1986 through May 1988, the rainfall deficit ranges from 42 inches below normal at Walhalla to 19 inches at Clarks Hill. Streamflows into the reservoirs within the upper portion of the basin have as a result been well below the historical average. Due to these low inflows, lake elevations at Lakes Jocassee, Keowee, Hartwell, Russell and Thurmond have been adversely affected. During the first half of 1988, elevations in the Corps lakes have been the lowest on record, with the exception of 1955. Due to the lowered lake elevations especially during 1986, SEPA purchased power in lieu of generating peak power from the three Corps lakes on the Savannah. Other adverse effects from the drought have included impacts to the recreational opportunities at Lakes Hartwell, Russell and Thurmond. Concern has also been expressed regarding the continued lowering of lake elevations on public water supply intakes in the lakes, property values, and the ability to maintain minimum releases from Lake Thurmond needed for downstream offstream and instream uses.

THE MODEL

The South Carolina Department of Natural Resources (SCDNR) has developed a hydrologic model for the Savannah River basin. The Savannah model simulates alternative operating policies for the Savannah River. In its current form, the model can follow one of two operating policies. The first is a single rule curve, where water is released from each reservoir so that the end of month level equals the rule curve. Additional releases are made if and only if minimum flow requirements downstream must be met. The second is a policy which keeps the reservoir between a primary and secondary rule curve. In this case the model attempts to optimize the value of the power produced over the run, while not violating the lower rule

curve. The reservoirs will not be drawn below the lower rule curve unless minimum releases downstream cannot otherwise be met. In the event that the reservoirs must be drawn below the conservation rule (first policy) or the lower rule curve (second policy), the user may specify that the deficiencies be allocated to maximize the value of power or to draw the reservoirs down on an equal percent of storage basis.

The model is set up to utilize inflow forecasts in determining releases. This allows the model to simulate the performance of the system under actual operating conditions, where system operators must utilize such forecasts in real time. The model requires that the forecasts to be used over the course of the run be presented as a single input data file.

The model can also be set to maintain minimum flows downstream of Lake Thurmond. These are specified as a time series for the entire run, for each reach in the model. Minimum releases from each reservoir can also be specified, one for each time period of the year.

The model is set up to use either a 1-week time step or a 4-week time step. The 4-week time step is called a month. Basically, the mode uses a "leapfrogging" procedure that works like this. Starting this period, we look ahead for the next operating horizon, which is NFPER periods long. We set some forecasted inflows for that horizon. The model then computes the optimal release schedule to maximize the value of power produced for the horizon. The model then fixes the first period of operations as the actual operations. Then it leapfrogs to the next period and repeats the process.